TIII:

Parallel Resonant Circuits

Unclassified

1 Hour Conference, W/ 2Hr PE1

Safety & Environmental Impact is “LOW”

TIII: PARALLEL RESONANT CIRCUITS

Terminal Learning Objective

Action: Given questions, Calculate Bandwidth, 1/2 Power Point, f1 & f2, Quality and Resonance. Also answer questions pertaining to operational characteristics of the Parallel Band Pass & Reject Filters.

Condition: White OMEMS Training Aid.

Standard: 70% Minimum.

Introduction

This lesson is much like Series Resonance the concepts are just the opposite of what you have learned previously, the math is just the same. The concepts acquired in this lesson will be helpful in the comprehension of the Sinewave Oscillators circuits in the next lesson.

Terms

TIII: PARALLEL RESONANT CIRCUITS

Terms & Formulas; Reference, White Gov Tng Aid.

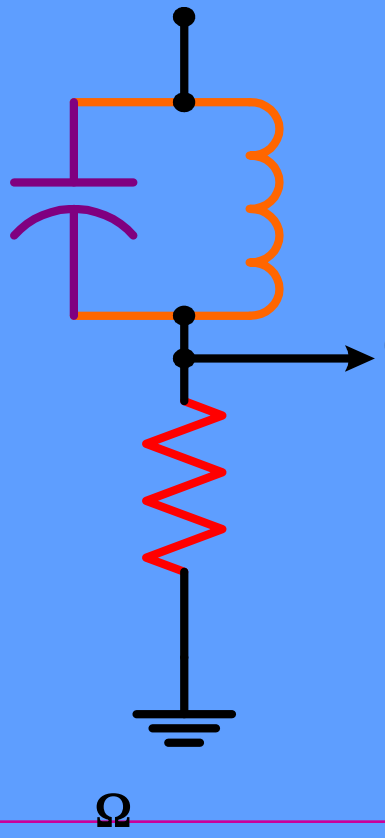
1. The Frequency were the XL = XC is called Resonance.
2. Opposition [Z] to Current Flow is Maximum.
3. Current Flow is Minimum.
4. @ Resonance the LC (Tank) acts like an open.
5. Above Resonance the Ckt behaves Capacitive.
6. Below Resonance the Ckt behaves Inductive.
7. **RESONANCE**; $1/ 2\pi \sqrt{LC}$, L X C = $\sqrt{X}$ ⇒ X 6.28 = 1/X ⇒ FR
8. **BANDWIDTH**; BW = f2 – f1
9. **½ POWER POINT**; PK Voltage X .707
10. **QUALITY**; $Q = F_R/BW$
11. BAND PASS;Output across the Parallel LC Tank, LC acts like an Open. Passes all, from f1 to f2 inclusive of Resonant Frequency.
12. BAND REJECT; Output across the Resistor, Shorts Signal to Gnd Rejects all, from f1 to f2 inclusive of Resonant Frequency.

Reactance

TIII: PARALLEL RESONANT CIRCUITS

Reactance;

Finding Reactance; X



Inductive Reactance; X_L 2π **FL =** X_L

6.28 X Freq X Inductor = X_L in Ω

Capacitive Reactance; X_C $1/2\pi$ **FC =** X_C

6.28 X Freq X Cap 1/X = X_C in Ω

Impedance; Z $\sqrt{\ R^2 + [X_L - X_C]^2}$

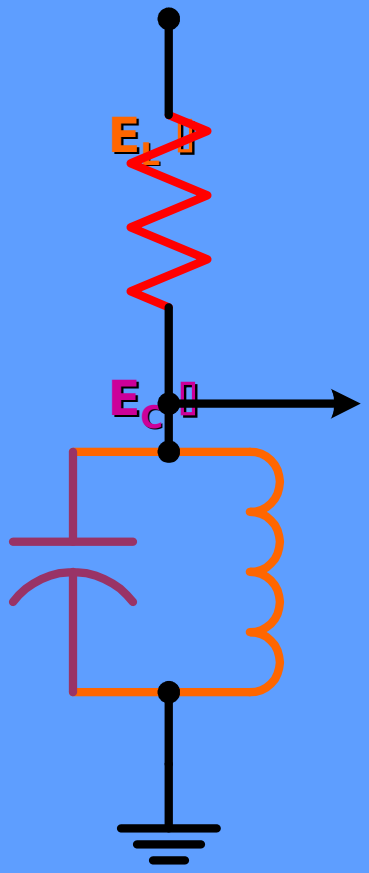
$X_L - X_C = X^2 + R\ X^2 = \sqrt{\ } X = Z$ in Ω

X & Freq

TIII: PARALLEL RESONANT CIRCUITS

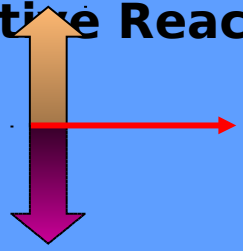
Reactance & Frequency;

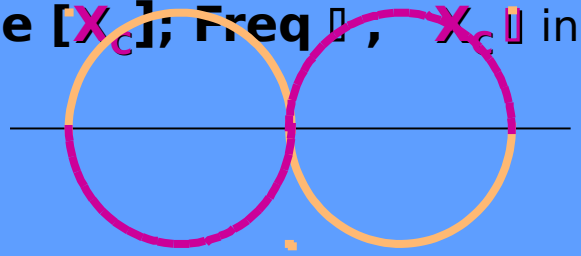
Relationship;



Inductive Reactance [X_L]; Freq ⇑, X_L ⇑ in Ω,

Capacitive Reactance [X_C]; Freq ⇑, X_C ⇓ in Ω,



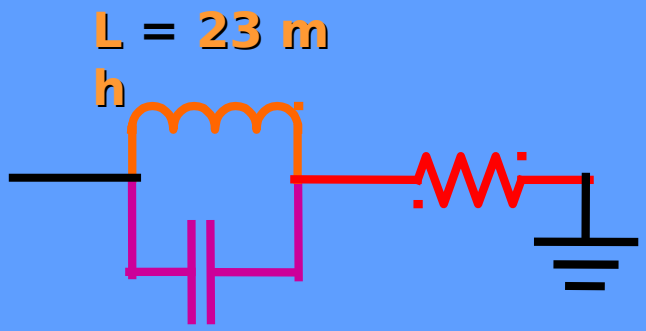


When the E_L & E_C are <u>equal</u> they will cancel each other out. The LC Tank will "act" like an Open.

Resonance

TIII: PARALLEL RESONANT CIRCUITS

Resonance; Determined by the Value of the Inductor & Cap



$$\frac{1}{2\pi\sqrt{\frac{L}{C}X}} = F_R$$

23 EE -3 X .09 EE -6 = $\sqrt{\ }$ X ⇒ X 6.28 = 1/X 2nd 6 ⇒ 3.499 KHz

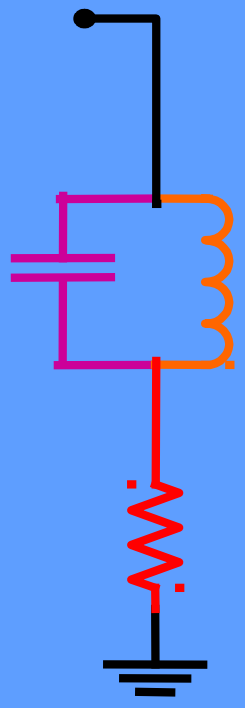
Note:

White Gov Tng Aid. Back, panel; F

Challenge

TIII: PARALLEL RESONANT CIRCUITS

Resonance; Calculate the Resonant Frequency $F_R = \frac{1}{2\pi\sqrt{L X_C}}$



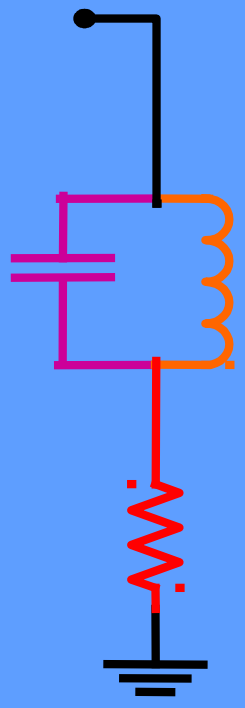
A.	B.	C.
L = 2 mh	L = 10 mh	L = 50 h
C = .05 μf	C = .05 μf	C = .03 μf
F_R = ____	F_R = ____	F_R = ____

$L X_C = \sqrt{X} \Rightarrow X \; 6.28 = 1/X \; 2^{nd} \; 6 \Rightarrow F_R$

Answers

TIII: PARALLEL RESONANT CIRCUITS

Resonance; Calculate the Resonant Frequency $F_R = \frac{1}{2\pi\sqrt{L X C}}$



A.	B.	C.
L = 2 mh	L = 10 mh	L = 50 h
C = .05 μf	C = .05 μf	C = .03 μf
F_R = 15.923 KHz	F_R = 7.126 KHz	F_R = 130 Hz

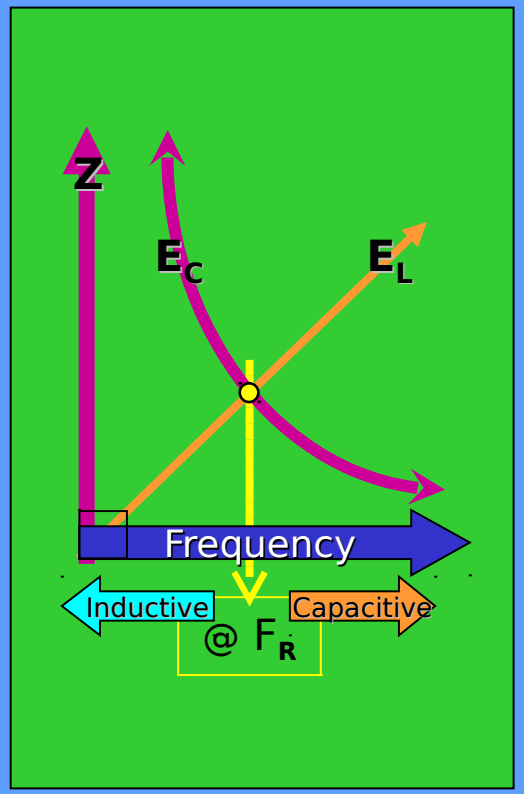
$L \times C = \sqrt{X} \Rightarrow X = 1/X \quad 2^{nd} \; 6 \Rightarrow F_R$

Chart

TIII: PARALLEL RESONANT CIRCUITS

Chart; Voltage current Relationship

Ref; White Tng Aid, Panel F



↓ F_R	@ F_R	↑ F_R
XC > XL	XL = XC	XL > XC
EC > EL	EL = EC	EL > EC
I ↑	I is Min	I ↑
Z ↓	Z is Max	Z ↓
Inductive	Resistive	Capacitive

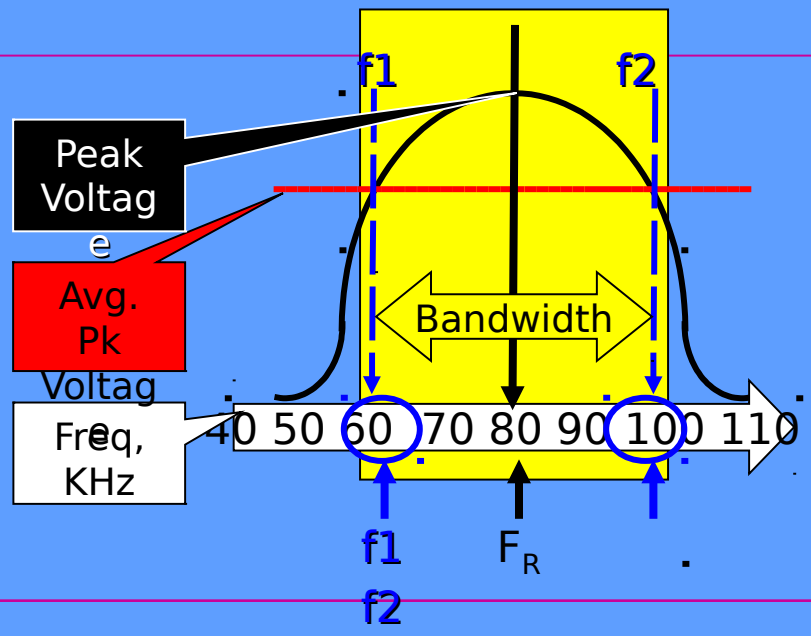
dwidth

TIII: PARALLEL RESONANT CIRCUITS

Bandwidth;

Ref; White Tng Aid, Panel **G**

Bandwidth describes those frequencies that a tuned Ckt dependant on the Value of the reactive devices is responsive to and will display the average Pk Voltage amplitude on the output between f1 & f2 frequencies. **BW = f2 – f1**



f2 – f1 = BW

100 - 60 = 40 KHz

The BW frequencies is 60 to 100 KHz

The Avg. Pk Voltage is Known as the

½ Power Point

½ Pwr Pt

TIII: PARALLEL RESONANT CIRCUITS

½ Power Point;

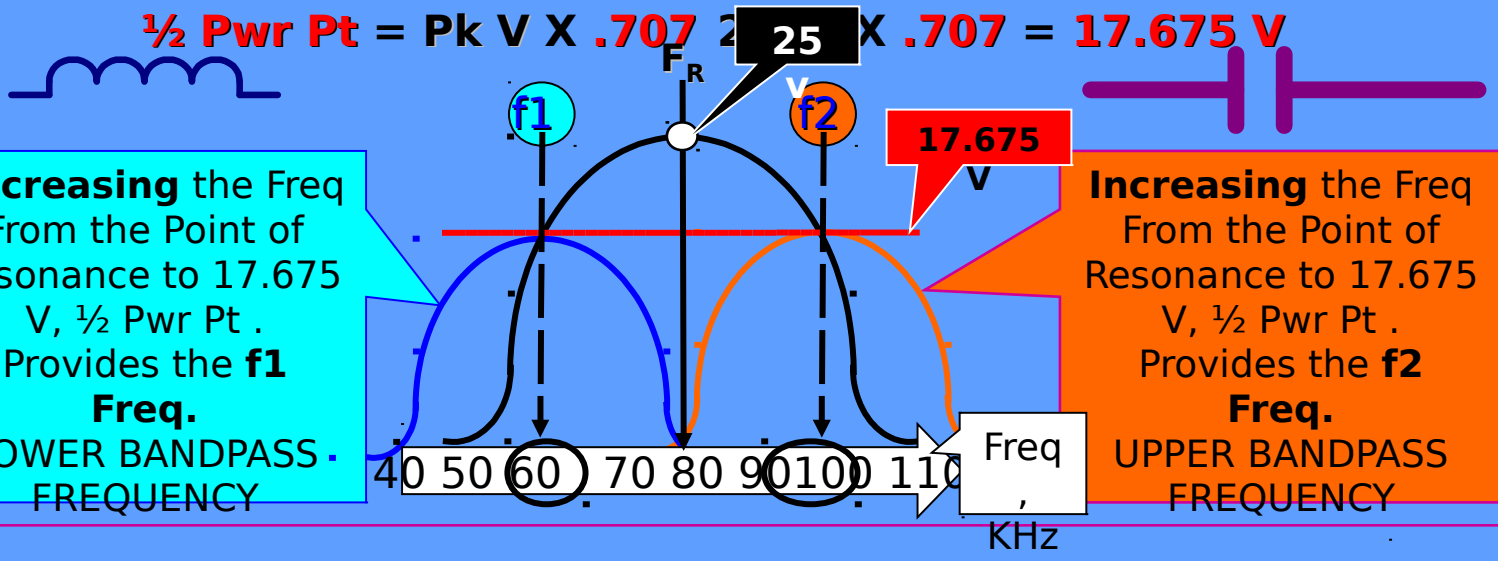
Ref; White Tng Aid, Panel **G**

½ Power Point describes the Avg. Pk voltage of the BW.

f1 Frequency; As the Freq is ↓ signal V ↓ to 70.7% of the Pk V.

f2 Frequency; As the Freq is ↑ signal V ↓ to 70.7% of the Pk V.

½ Pwr Pt = Pk V X .707 25 X .707 = 17.675 V



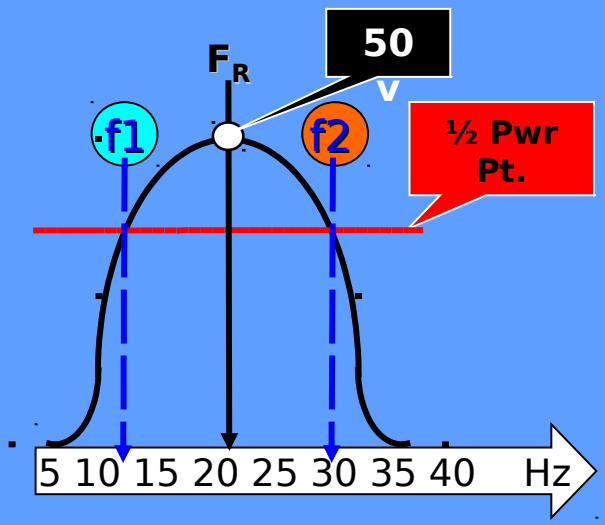
Decreasing the Freq From the Point of Resonance to 17.675 V, ½ Pwr Pt . Provides the **f1 Freq.** LOWER BANDPASS FREQUENCY

Increasing the Freq From the Point of Resonance to 17.675 V, ½ Pwr Pt . Provides the **f2 Freq.** UPPER BANDPASS FREQUENCY

Challenge

TIII: PARALLEL RESONANT CIRCUITS

Determine the following Ckt Parameters.



F_R = ____

½ Pwr Pt = ____

f1 = ____

f2 = ____

BW = ____

Q = ____

Q Describes the selectivity of the Ckt. A High Q, a Increased Selectivity. A Low Q, a Decreased Selectivity. Sometimes referred to as the Quality [illegible]

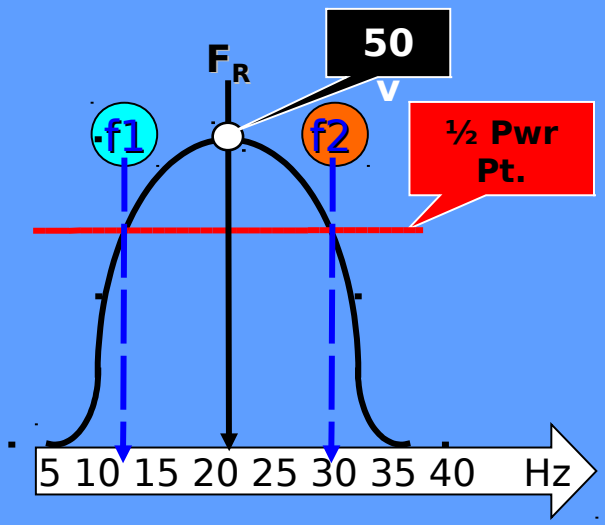
$$Q = \frac{FR}{BW}$$

Ref; White Tng Aid, Panel **G**

Answers

TIII: PARALLEL RESONANT CIRCUITS

Determine the following Ckt Parameters.



F_R = 20 Hz

½ Pwr Pt = 35.35 V

f1 = 10 Hz

f2 = 30 Hz

BW = 20 Hz

Q = 1

Q Describes the selectivity of the Ckt. A High Q, a Increased Selectivity. A Low Q, a Decreased Selectivity. Sometimes referred to as the Quality [illegible]

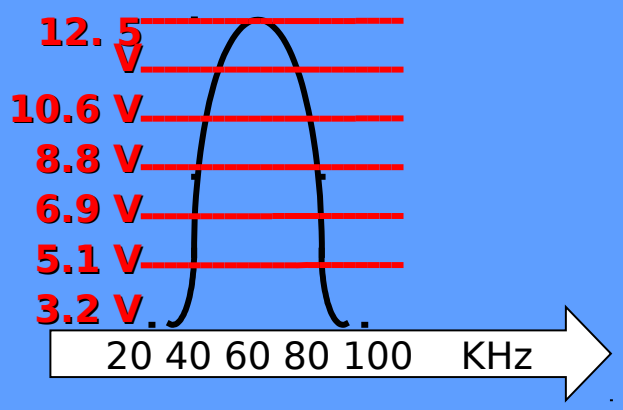
$$Q = \frac{FR}{BW}$$

Ref; White Tng Aid, Panel **G**

Challenge 2

TIII: PARALLEL RESONANT CIRCUITS

Determine the following Ckt Parameters.



EF_R = _____

F_R = _____

½ Pwr Pt = _____

f1 = _____

f2 = _____

BW = _____

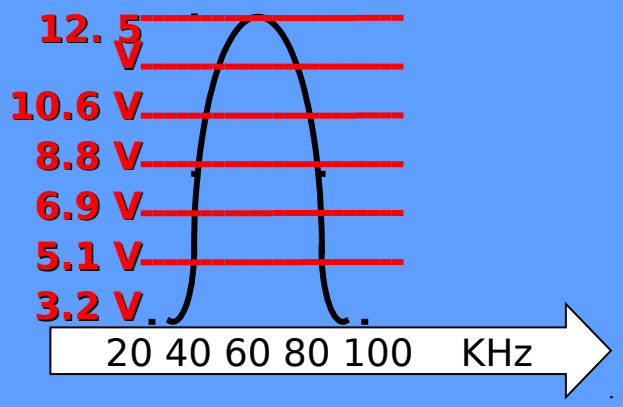
Q = _____

Ref; White Tng Aid, Panel G

Answers

TIII: PARALLEL RESONANT CIRCUITS

Determine the following Ckt Parameters.



EF_R = 12.5 V

F_R = 60 KHz

½ Pwr Pt = 8.8 V

f1 = 40 KHz

f2 = 80 KHz

BW = 40 KHz

Q = 1.5

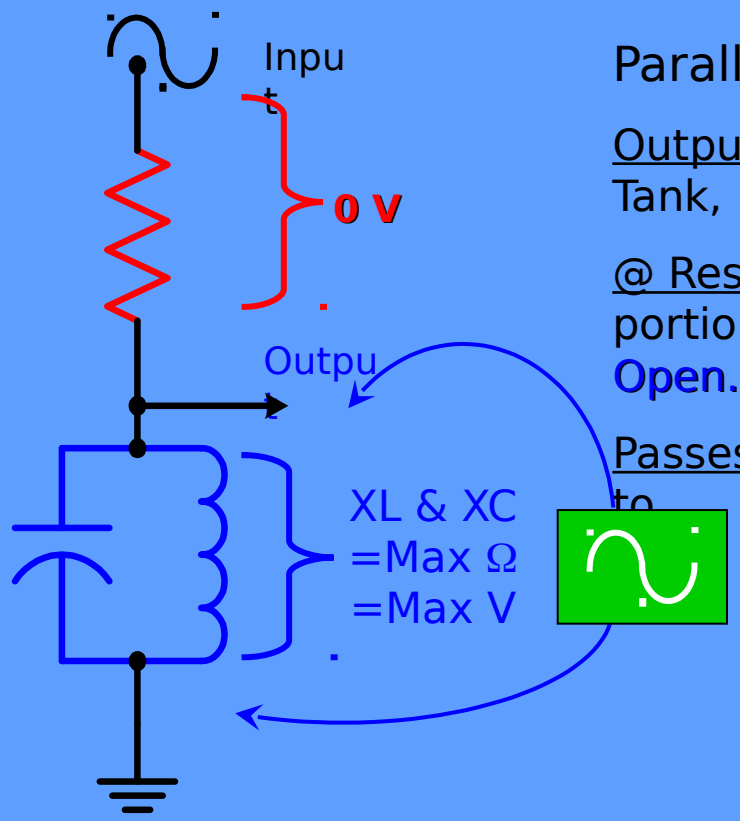
Ref; White Tng Aid, Panel G

Band Pass Filter

TIII: PARALLEL RESONANT CIRCUITS

Parallel Band Pass Filter;

Ref; White Tng Aid, Top Left Panel E

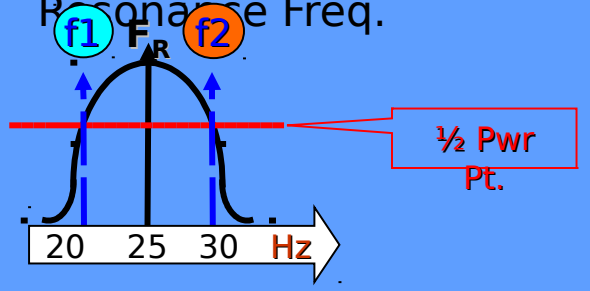


Parallel Band Pass Filter;

Output; Taken across the LC Tank, in ref. to Gnd.

@ Resonance; The LC Tank portion acts like an Open.

Passes; All Frequencies from f1 to f2 inclusive of the Resonance Freq.

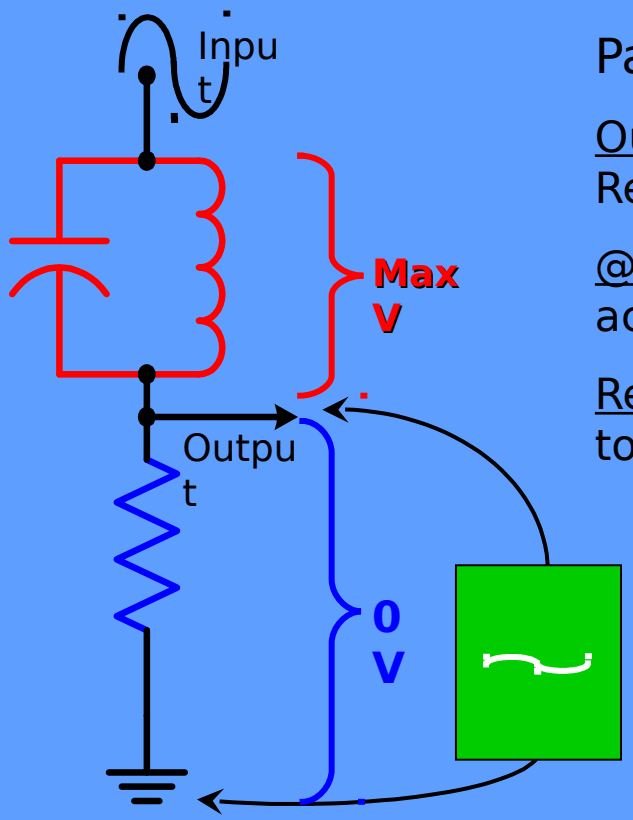


Band Reject Filter

TIII: PARALLEL RESONANT CIRCUITS

Parallel Band Reject Filter;

Ref; White Tng Aid, Top Left Panel **E**

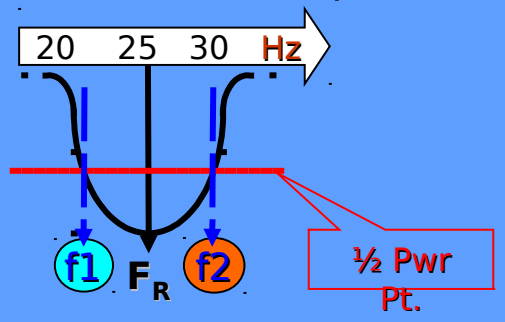


Parallel Band Reject Filter;

Output; Taken across the Resistor, in ref. to Gnd.

@ Resonance; The LC portion acts like a Open.

Rejects; All Frequencies from f1 to f2 inclusive of the Resonance Freq.



Problem Sheet

TIII: PARALLEL RESONANT CIRCUITS

Problem Sheets; 10 Problems

1. Calculate Resonance Frequency for each of the following LC values.

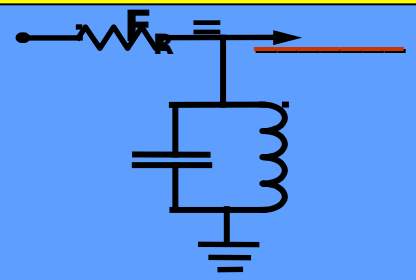
a. **C = .005 μf** **L = 200 mh** **F_R = _____**

b. **C = .02 μf** **L = 600 mh** **F_R = _____**

c. **C = .04 μf** **L = 400 mh** **F_R = _____**

d. **C = .001 μf** **L = 20 mh** **F_R = _____**

e. **C = .09 μf** **L = 10 mh** **F_R = _____**



2. What type of Filter is illustrated?

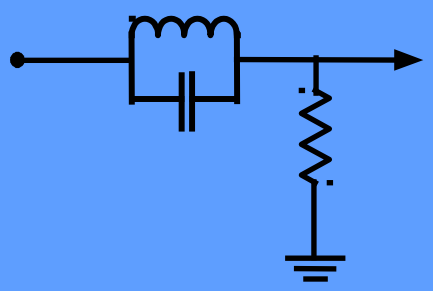
_____

Answers 1 & 2

TIII: PARALLEL RESONANT CIRCUITS

Problem Sheets; 10 Problems,

3. What type of Filter is illustrated?



_____

4. Below the FR a Parallel LCR filter Acts _____ .
5. Above the FR a Parallel LCR filter Acts _____ .
6. @ FR Current is _____ in an LCR Ckt.
7. @ FR Impedance is _____ in an LCR Ckt.

Answer 3-7

TIII: PARALLEL RESONANT CIRCUITS

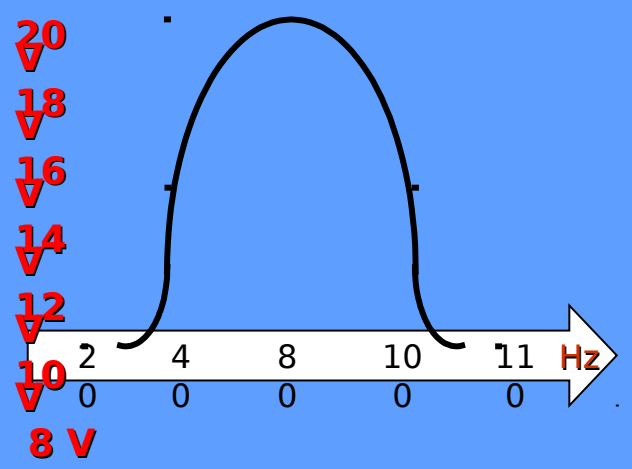
Problem Sheets; 10 Problems,

Note; For Question 8-10 calculate the operating parameters using the associated illustration and the ½ Pwr point for the f1 & f2 frequency's.

8.

a. F_R _____
b. 1/2 Pwr Pt V _____
c. f2 _____
d. f1 _____
e. BW _____
f. BW Frequencies

_____
e. Q _____



Answer 8

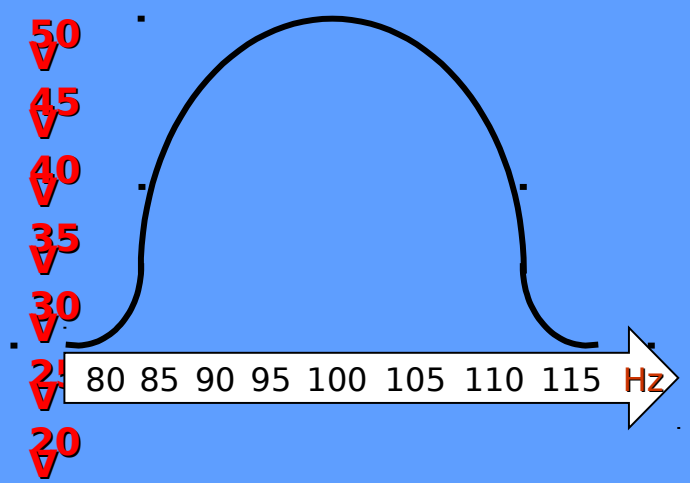
TIII: PARALLEL RESONANT CIRCUITS

Problem Sheets; 10 Problems,

Note; For Question 8-10 calculate the operating parameters using the associated illustration and the ½ Pwr point for the f1 & f2 frequency's.

9.

a. F_R _____
b. 1/2 Pwr Pt V _____
c. f2 _____
d. f1 _____
e. BW _____
f. BW Frequencies _____
g. Q _____



Answer 9

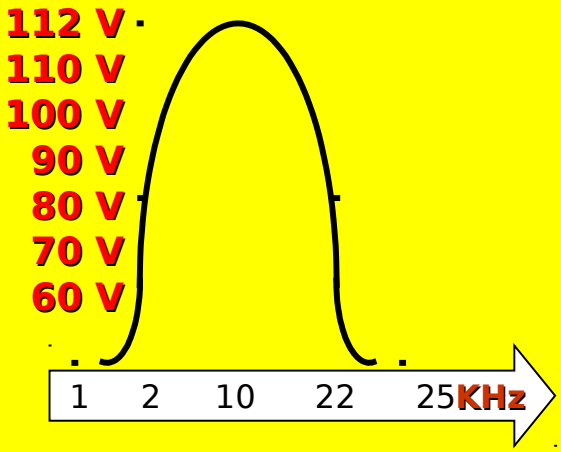
TIII: PARALLEL RESONANT CIRCUITS

Problem Sheets; 10 Problems,

Note; For Question 8-10 calculate the operating parameters using the associated illustration and the ½ Pwr point for the f1 & f2 frequency's.

10.

a. F_R _____
b. 1/2 Pwr Pt V _____
c. f2 _____
d. f1 _____
e. BW **25 Hz**
f. BW Frequencies _____
g. Q ____



Answer 10

TIII: PARALLEL RESONANT CIRCUITS

Lesson Test;

Lesson Test:

Standard: 10 Questions W/in 20 Minutes. 70% Minimum Accuracy. Reference: White OMMCS Tng Aid.

$$L \times C = \sqrt{X} \Rightarrow X\ 6.28 = 1/X\ 2^{nd}\ 6 \Rightarrow F_R$$

Close